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Research Briefs

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Nutrition and Health

Regular aerobic training can improve fitness of inactive people in their 60's just as much as couch potatoes in their 20's. But the improvements occur differently in each age group, a study shows. Researchers measured both aerobic capacity (VO_2 max) and the oxygen-burning capacity of thigh muscle in 20 men and women—10 older and 10 younger. They were tested before and after 12 weeks of cycling 3 times per week. Gains in aerobic capacity were about the same for both age groups. But virtually all the older group's improvement was due to the ability of their muscles to use more oxygen—not to the ability of their hearts to pump more blood, and thus more oxygen, to the muscles. By contrast, the younger group improved in both functions. The findings corroborate other reports that endurance exercise improves older people's fitness but doesn't significantly improve the maximum amount of blood the heart can pump.

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As we age, it takes longer for the fat we eat to move out of the bloodstream and into cells, a new study shows. This explains why, in an earlier study, older people had significantly more fat circulating in their blood after a fat-rich meal

than younger people. Since elevated triglycerides—as fats are called—contribute to the risk of heart disease, senior citizens now have even more reason to restrict their fat intake. Researchers compared the time it took a group of men and women over 60 to clear dietary fat from their blood with another group under 30. Fat clearance took nearly twice as long in the older group.

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A state-of-the-art method for measuring trace elements in foods is producing significant differences in some values listed in USDA's Food Composition Tables (Handbook 8). These tables have been used for years by dietitians and researchers to estimate nutrient intake. But the values for some elements, such as copper and iron, include data from analyses done more than 40 years ago using now outdated analytical methods. Recently, ARS researchers used plasma emission spectroscopy to measure nine trace elements in 15 foods covering the major food groups. Most of the values compared well with the tables. Copper and manganese levels disagreed most often, probably because older methods could not detect the very low concentrations found in many foods. For example, canned peaches had twice the level of copper stated in the tables, while whole wheat bread had 20 percent less. But whole wheat bread scored nearly 30 percent higher in iron, apparently due to iron fortification. The research also provided values where there were none before, such as the manganese content of dairy products, whole wheat bread and canned pineapple.

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A device many health clubs, nutrition clinics and research labs use to quickly and easily measure body fat is now more precise, thanks to experiments by ARS scientists and colleagues at three other labs. They measured more than 1,500 volunteers from the East and West Coasts, using both the portable, commercially developed device—known as an impedance meter—and an older, well-established approach—underwater weighing. Data from those tests enabled scientists to increase the meter's accuracy so that readings now more closely agree with those from the slow, cumbersome and often uncomfortable underwater weighing. The meters measure the electrical resistance that occurs when

body fat—a poor conductor of electricity—impedes a harmless, low-level current sent from electrodes placed on hands and feet. Body fat measurements may be a better indicator of health than body weight. So ARS researchers rely on the meters as well as other approaches to determine healthful levels for Americans of different ages, bone structures and ethnic groups.

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People in lesser developed countries, who must rely heavily on small grains for food, are being shortchanged on some of the grains' calcium and trace minerals. This is because phytic acid, a natural compound in rice, wheat and other cereals, prevents nutrient absorption in the intestinal tracts of humans and livestock. A plant geneticist has found that the phytic acid content in wheat is directly related to the kernel's protein and phosphorus contents. This poses a dilemma for plant breeders—if they were to breed grains with lower phytic acid, the grain also would have less protein and phosphorus. To solve the problem, the geneticist is using tools of biotechnology to develop germplasm that does not produce phytic acid. This germplasm might provide the parents of future small grain varieties that would supply more total nutrients.

*Cereal Crops Improvement, Bozeman, MT
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A diet high in fructose sugar and lacking in copper caused major cardiovascular damage in pigs. Numerous studies with rats have produced similar results. But the findings with pigs are significant for two reasons: The fructose content was only twice the level in the average U.S. diet, which is generally low in copper. And pigs have a cardiovascular system very similar to humans. After 10 weeks on the copper-deficient diet containing 20 percent of calories as fructose, the pigs' hearts were twice the size of the other test groups. The animals were also anemic and had enlarged livers and low levels of copper-containing enzymes—including one that prevents aneurysms in blood vessels. The diets of the other test groups contained either adequate copper or glucose instead of fructose—the two sugars are metabolized differently—or both adequate copper and glucose.

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A diet lacking vitamin B₆ produced a sharp increase in the serum insulin level of four men in their 60's. Though the number of people tested was small, the results are noteworthy because elevated serum insulin can be an early warning sign of diabetes. It indicates the hormone has become less efficient at processing glucose from a meal. During the

study, the four men's fasting serum insulin levels climbed 131 percent after less than 3 weeks of eating a diet virtually devoid in the vitamin. But the four women in the study showed no significant increase. The men also had a slight increase in serum glucose. As B₆ was added back to the diet gradually over two months, the men's insulin levels dropped but did not return to starting levels. Additional research is needed before any conclusions can be reached on whether a B₆ deficiency promotes diabetes.

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Getting enough calcium and zinc in people's diets is a worldwide problem, according to preliminary results from the first uniform international study of mineral intakes. Analysis of one-third of 450 sample diets collected from 11 developed and developing nations—including the United States—showed the calcium content ranged from 25 to 75 percent of the U.S. RDA, while zinc content measured between 55 and 95 percent. ARS scientists were involved in designing the study and developed the composite-diet standard being used by the eight international testing labs to ensure uniformity of results. The study, coordinated by the International Atomic Energy Agency in Vienna, Austria, is looking at intake levels of 23 elements, including 6 toxic elements. So far, all nations exceed the U.S. RDAs for potassium, magnesium, molybdenum and the constituents of table salt—sodium and chlorine. The lowest U.S. intake was for calcium at 70 percent.

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To see if you're getting enough niacin, physicians may someday use a technique that tests a small sample of blood. Developed by researchers with ARS and the University of California at Los Angeles, the new approach is more convenient than a urine test that requires round-the-clock collections. In the body, niacin is converted into two major forms, NAD or NADP. In volunteers fed low-niacin meals, red blood cell levels of NAD dropped some 70 percent, but NADP levels didn't change. Those volunteers with an NAD-to-NADP ratio of less than 1 were niacin-deficient. Using this ratio as an early signal of niacin depletion is new. With more work, a test based on the ratio could become part of routine health checkups in the United States. It could also aid health workers in developing countries gauge progress in fighting severe niacin deficiency, which causes pellagra. Niacin—one of the B vitamins—comes from meat and dairy products.

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Tomorrow's Foods

Cholesterol-lowering compounds in oats might be added to those breakfast cereals and other foods that now contain little or no oats. These include breads and the cereal extenders in some processed meats. ARS researchers developed a new method for recovering beta-glucans—found mainly in cell walls of oat kernels—in a concentrated powder. Levels of beta glucans were two to five times higher in the concentrate than in an equal volume of natural oat bran or rolled oats. The method has two advantages that raise its efficiency and potential appeal to commercial millers. First, it is a dry-milling process. This is more desirable than wet milling with a water-enzyme mixture that could damage the beta-glucans. Second, the method gives a surprisingly high—that is, 20 to 38 percent—yield of concentrate. That means 20 to 38 pounds of the powder could be made from 100 pounds of oat bran or rolled oats. The remaining material isn't waste; it can be used as flour. Further tests will refine the method and improve its commercial potential.

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Omega, a new flax variety, packs three pluses in its seed. First, it contains omega-3, a family of fatty acids that researchers think may help reduce a person's risk of developing cardiovascular disease. Second, Omega's golden-tinted seeds are ideally suited for grinding and blending into flour to impart a nutty flavor to baked products. Additionally, Omega is the first yellow-seeded flax variety with genes to resist all prevalent races of rust diseases in North America—a bonus for farmers. Omega's yields in tests have been similar to those of typical brown-seeded flax varieties. Developed by ARS and North Dakota State University scientists, the new variety may be ready for full production as early as 1992.

*Oilseeds Research, Fargo, ND
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Miniature iceberg lettuce may appear in trendy restaurants and supermarket produce sections by 1993. Only the size of a tennis ball, the midget lettuce is ideal for people who can't seem to use up a whole head while it's still fresh. Cut into wedges, it makes a single-serving salad. And it boasts the same crisp texture, sweet taste, and tightly formed head as commercially grown iceberg lettuce. ARS scientists produced the new variety by first soaking thousands of germinating lettuce seeds in an ethyl methanesulfonate compound. Plant researchers and breeders commonly rely on this approach to change how plants grow. The soaking altered a gene critical to a natural growth hormone called gibberellin. This caused some of the plants to produce 90 percent less of the hormone than their regular-size cousins.

When scientists crossed the new plants with Salinas iceberg—a popular, full-sized variety bred by ARS—they obtained a midget lettuce that's the familiar green and another with blush-red outer leaves.

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Three new high-yielding, disease-resistant pecan varieties are making their debut in southern U.S. tree nurseries. Nuts from the variety, Osage, mature early in the fall, when pre-holiday prices are highest. This also gives the tree time to replenish its nutrient reserves for flowering the next spring. The Oconee variety has excellent quality nuts. Trees of the Houma variety resist the fungal disease scab. That could boost Houma's popularity in states such as Georgia, where pecan producers sometimes spray against scab as often as 10 times a year. Nurseries may be selling these varieties within 2 years.

*Pecan Genetics and Improvement Research, Somerville, TX
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Hawaii's premium avocado, the smooth and creamy Sharwil, is being shipped to the mainland this winter, thanks to ARS research. Tests were made on more than 200,000 avocados in the lab, avocado groves and packinghouses to ensure that fruit flies, such as the Medfly, can't stow away in fruit shipments. Experiments indicated that the best chemical-free tactics for outwitting the flies include leaving avocado stems attached when harvesting the fruit and, within 12 hours after harvest, packing the fruit in fly-proof containers at fly-free packinghouses. USDA's Animal and Plant Health Inspection Service relied on the findings to lift a ban that had long prohibited shipments of Hawaii's avocados to any state except Alaska, where the climate is too cold for tropical fruit flies. Pebbly-skinned Sharwils are about twice as big as the popular Hass avocado.

*Tropical Fruit and Vegetable Research Lab, Hilo, HI
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Blueberry seedlings have been successfully infected with several strains of the bacterium *Agrobacterium tumefaciens* as a first step toward genetically improving these plants. For example, to fruit properly, blueberry plants require a certain number of chilling hours. If this process could be genetically triggered instead of relying upon weather conditions, growers could obtain more consistent, higher quality production. Blueberries also are susceptible to many diseases, and their growth is restricted to certain soil types. Next step for researchers: To see if these characteristics could be genetically manipulated via *Agrobacterium*, which is commonly used to introduce desirable traits in other kinds of plants.

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Food and Water Freshness and Safety

Computers can now forecast each stage in processing food, from raw material to end product. Being able to predict interactions that occur among individual processing steps can help processors improve product quality, yield and nutritional value. Developed by ARS scientists, this new computer program mimics what happens on food processing lines. It uses mathematical calculations to determine proper on-line processing conditions such as cooking, blanching and drum drying. Taken into account are factors like the make up of raw material, temperature and the amount of material processed at a given time. ARS has had inquiries on this technology from at least 100 companies.

Engineering Science Research, Philadelphia, PA
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Squalene, a natural skin lubricant in humans and a feather lubricant in birds, can also protect grapefruit from chilling injury. Chilling injury doesn't harm the fruit, but causes brownish pits on the rind that lessen market value. An ARS chemist found squalene in the wax of grapefruit rind. Tests showed that storing the fruit for 7 days at 60 degrees F increased the level of squalene 33 times. That temperature caused fruit to produce the most squalene. In one storage test, only 6 percent of conditioned fruit developed chilling injury compared to 97 percent not temperature conditioned. Squalene had not been identified in citrus before. It is present in large quantities in shark liver oil, olive oil, wheat germ oil, rice bran oil and yeast.

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Farmers and homeowners can reduce water pollution while maintaining good crop yields with the aid of a computer software package designed by ARS researchers. Called NLEAP—Nitrate Leaching and Economic Analysis Package—it is designed to help farmers and homeowners make decisions about fertilizing practices that will minimize the potential for nitrate leaching. Nitrogen in the form of nitrate is the major agricultural contaminant of groundwater. NLEAP can be used on a personal computer. Users can tap into local and state soil and climate data. It also includes optional national soil and climate information. The software and a book, "Nitrogen Management for Groundwater Quality and Farm Profitability," will soon be made available through the Soil Science Society of America.

Crops Research Lab, Fort Collins, CO
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Checking a corn plant's complexion—for greenness—is one innovative way ARS scientists are monitoring the quality of groundwater and saving farmers money. For better precision, scientists confirmed that a commercially

developed chlorophyll meter, used to check nitrogen levels in rice, can work on other crops. That means farmers can use this hand-held meter to see how healthy the plant is at a given time, based on its greenness. (Greenness is related to the level of nitrogen in the plant.) Using the meter gives farmers the option of applying less nitrogen fertilizer at planting and perhaps adding more later if needed. Soil tests for nitrogen can take several days to weeks. As nitrogen applications are reduced, so is the risk of contaminating groundwater supplies with fertilizer leaching or runoff.
Soil and Water Conservation Research Lab, Lincoln, NE
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Consumers who savor the nutlike taste of wild rice may be able to buy graded rice within 3 to 5 years. That's because ARS scientists have refined techniques for assigning grades to wild rice, somewhat like those used for other grains, or meat and poultry products. California's wild rice growers asked the scientists to provide easy-to-follow steps that grain inspectors can use to weigh, measure and judge rice accurately and consistently. Growers and processors contemplate a grading system that will apply to the freshly harvested "green" grain or the familiar processed rice—the roasted, glossy black or light brown grains you buy at the store by the box, bag or scoop. Consistency within each grade and among growers and processors is especially important to food manufacturers who buy wild rice for packing in mixes with white or brown rice. In those products, all grains must cook uniformly in the time shown on the box. Once growers and processors agree on grading procedures and standards, the next step will be to propose a federally approved grading system.

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